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DIRECT MEASUREMENTS OF DAYTIME AND NIGHTTIME PROFILES OF CHARGED PARTICLE CONCENTRATION BELOW 80 KM

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SUMMARY

This note discusses certain possible causes of formation of local diurnal minima of ion concentration in the stratosphere on the basis of measurements of daytime and nighttime profiles of charged particle concentration below 80 km.

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As a rule, the devices installed in geophysical rockets are applied in a single experiment. The retrieval system does not assure the total preservation of all the nodes of the measuring complex after landing. The impossibility of recurrent measurements of charged particle concentration by means of one and the same device [1, 2] compelled us, so far, to be prudent when intepreting the obtained results.

In April 1966, we succeeded to measure at middle latitudes in the USSR the daytime and nighttime profiles of charged particle concentration below 80 km using the same device. During a recurrent night launching the entire measurement apparatus and the power fed were identical to those of the first daytime launching. The method of measurements of charged particle concentration is described in [1, 2]. The interval between nighttime and daytime measurements constituted 6 days. The Sun was quiet. The ballistic characteristics were practically identical in both experiments (the greatest difference between the trajectories did not exceed 2 km).

The results of measurements are shown in Fig.1, where N^+ is the concentration of charged particles of same sign, for example, positive ions.

The profile of daytime concentration of positive ions (19 April. 1400 h. local time) was plotted by experimental points represented by clear circles. The double circle in the upper part of the graph indicates the measurement obtained over the ascending part of the trajectory. The night profile is drawn by black circles and corresponds to the concentration of positive ions measured on 25 April at 2330 hours local time. When determining the absolute values of concentrations, a twofold error is possible, and the relative errors are determined by the scattering of points in the graph.

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* PRYAMYYE IZMERENIYA DNEVNOGO I NOCHNOGO PROFILEY KONTSENTRATSII ZARYAZHENNYKH CHASTITS NIZHE 80 KM.

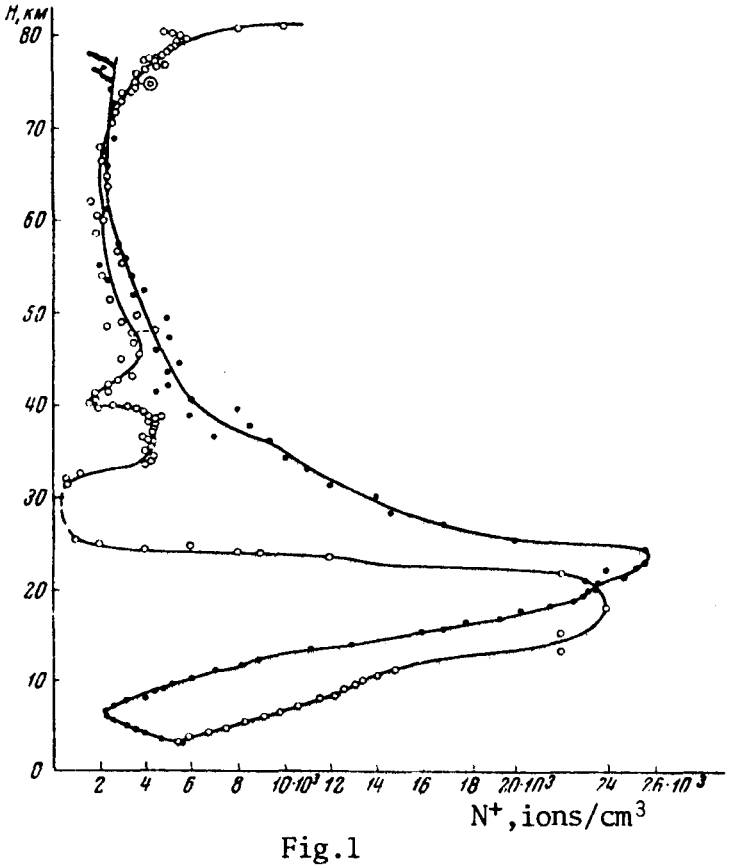

Fig.1

Analyzing the curves of ion concentration dependence on altitude at daytime and nighttime, it is possible to conclude that:

1) the earlier noted ion content in the stratosphere is confirmed [1], namely, maximum at approximately 10 - 40 km and minimum concentration in approximately the 50 - 70 km range;

2) the night profile of ion concentration has a maximum approximately between 10 and 40 km and a minimum between 50 and 70 km;

3) there are in daytime and below 50 km local minima of concentration against a background of charged particle concentration in the stratosphere and upper troposphere;

4) below 70 and 20 km there are more light ions in nighttime than in daytime;
5) above 70 km there are more charged particles in daytime than at night;
6) above 20 km a sharp decrease of ions, local, as well as general, is noted at daytime by comparison with the nighttime in the upper part of the stratospheric maximum.

In other words, the last two experiments have confirmed the fundamental correctness of the conclusions arrived at in [1 - 4]. It was noted in these works that the emergence of a stratosphere ionized layer is due to the ionizing action of secondary cosmic rays, the intensity of which is maximum between 10 and 30 km.

The general decrease of ion concentration below 70 km is explained by the increase of the effective recombination coefficient as a result of the photodetachment process of electrons from negative ions [4]. It is assumed in [4] that O_2 is the prevailing negative ion below 70 km and it is admitted that the so called "O_2 - model" stands. In principle it is possible to explain the local minima of ion concentration in the stratospheric ionized layer by the photodetachment process; however, in this case one is led to utilize in the calculations such attachment and detachment coefficients, which are currently controversial.

The appearance in daytime of local minima of ion concentration below 50 km requires an explanation. The assumption was ventured in [5] (though in truth only for the 60 - 80 km range) that the recombination coefficient may rise sharply because of the presence in the atmosphere of dust particles. Laboratory measurements show that the same takes place in the presence of water vapors [6]. We shall add to this that, inasmuch as the regime of device's operation is not calculated for the registration of heavy ions (charged particles of dust and water), it may ensue that the detected local minima constitute regions where heavy ions prevail. It is also possible that the formation of local minima is somehow linked with the fact that the latter are disposed at places with maximum ozone content.

Such are certain possible causes of formation of local diurnal minima of ion concentration in the stratosphere.

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****** THE END ******

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